ization of the light reflected from the spatial light modulator **120**, thereby more efficiently branching the incident light and the emission light.

[0060] A reflection member **113** may be between the light source **111** and the light brancher **130**. The reflection member **113** may be a total reflection prism or a mirror. The reflection member **113** may be provided for an appropriate layout of optical members such as the light source **111**, etc. in a limited space of the housing **190**.

[0061] The relay optical system **140** may be a modified **4** f optical system that expands or reduces and transfers the image of the hologram wavefront generated by the spatial light modulator **120**.

[0062] With further reference to FIG. **3**, as an example, the relay optical system **140** may include a first relay lens **141**, e.g., a first optical element, having a first focal distance f**1** and a second relay lens **143**, e.g., a second optical element, having a second focal distance f**2**. The first relay lens **141** may be provided such that the modulating surface **12** of the spatial light modulator **120** is positioned at a location of the first focal distance f**1** on a side of an incident surface **14** of the first relay lens **141** or near the location of the first focal distance f**1** on the side of the incident surface **14**. The second relay lens **143** may be provided such that the second focal distance f**2** on a side of an incident surface **16** of the second relay lens **143** is positioned at a location of the first focal distance f**1** on a side of an emission surface **18** of the first relay lens **141** or near the location of first focal distance f**1** on the side of the emission surface **18**. According to an optical layout of the relay optical system **140**, the image of the hologram wavefront generated on the modulating surface of the spatial light modulator **120** may be imaged at the second focal distance f**2** on a side of an emission surface **20** of the second relay lens **143**. The image of the hologram wavefront imaged by the relay optical system **140** is referred to as an imaged spatial light modulation (SLM) **172**.

[0063] The first focal distance f**1** may be different from the second focal distance f**2**. For example, the second focal distance f**2** may be larger than the first focal distance f**1**, thereby the relay optical system **140** may expand the imaged SLM **172**. Alternatively, the first focal distance f**1** may be larger than the second focal distance f**2**, thereby the relay optical system **140** may reduce the imaged SLM **172**. As described below, since a size of the imaged SLM **172** is in proportion to a viewing angle (VA), the VA may be changed by expanding or reducing the imaged SLM **172**.

[0064] The noise removal filter **150** may be provided at a location where the first focal distance f**1** on the side of the emission surface of the first relay lens **141** and the second focal distance f**2** on a side of the incident surface of the second relay lens **143** overlap each other or near the location. The noise removal filter **150** may be, for example, a pin hole. The noise removal filter **150** may be placed at the first focal distance f**1** of the first relay lens **141** of the relay optical system **140** and may block light except light of a desired diffraction order, thereby removing noise such as a diffraction pattern or multiplex diffraction due to a pixel structure of the spatial light modulator **120**.

[0065] As described above, the image of the hologram wavefront formed on the modulating surface of the spatial light modulator **120** may form the imaged SLM **172** by the relay optical system **140**. The field lens **170** may focus the imaged SLM **172** in front of the pupils **13** of the user **10** to form the viewing window in front of the pupils **13** of the user **10**. The viewing window may be understood as a space for the user **10** to see the hologram image.

[0066] The light path converter **180** may be a beam splitter that reflects the diffraction light transferred from the relay optical system **140** and allows the external light Lo to be transmitted therethrough. The light path converter **180** may be disposed where a light beam incident on and transmitted through a first incident surface **180***a* is reflected from a beam separation film **181** located inside the light path converter **180** and is emitted to an emission surface **180***c*, and a light beam Lo incident on and transmitted through a second incident surface **180***b* transmits through the beam separation film **181** and is emitted to the first emission surface **180***c*.

[0067] As an example, the beam separation film **181** may be a half mirror. In this case, the light emitted by the light source unit **110** does not need to be a polarized light.

[0068] As another example, when the light emitted by the light source unit **110** has polarization, the beam separation film **181** of the light path converter **180** may be a polarization selective reflection film. If a polarization direction of the light beam incident on the first incident surface **180***a* is a first polarization direction, and a polarization direction orthogonal to the first polarization direction is a second polarization direction, the beam separation film **181** may have polarization selectivity so that light having the first polarization direction is reflected, and light having the second polarization direction is transmitted. Since the external light Lo has both a first polarization component and a second polarization component, if the beam separation film **181** has the polarization selectivity, only the second polarization component included in the external light Lo incident on the second incident surface **180***b* may be transmitted through the beam separation film **181** and may reach the pupils **13** of the user's eyes **11**.

[0069] The first incident surface **180***a* of the light path converter **180** may be adjacent to the field lens **170**. The emission surface **180***c* of the light path converter **180** may be adjacent to the pupils **13** of the user's eyes **11**.

[0070] The light path converter **180** may be an example of an optical member that changes at least one of a path of the diffraction light of the hologram image transferred from the relay optical system **140** and a path of the external light Lo and transfers the diffraction light and the external light Lo to the same region (i.e., the pupils **13** of the user's eyes **11**).

[0071] As described above, the see-through holographic display apparatus **100** according to an exemplary embodiment may be the wearable apparatus worn on the head of the user **10**, and thus the housing **190** may have a shape of one-eye glasses that may be a device closely mounted on an eye of the user **10**, on a side of a face from an eye to an ear, or may have a shape attached to one of the lenses of glasses.

[0072] For example, the housing **190** may include a first housing portion **190**A adjacent to an ear, a bent portion **190**B, and a second housing portion **190**C adjacent to the eye **11**. The first housing portion **190**A, the bent portion **190**B, and the second housing portion **190**C may be integrally formed but are not limited thereto. The first housing portion **190**A may be provided with, for example, the light source unit **110**, the spatial light modulator **120**, the light brancher **130**, the relay optical system **140**, and the noise removal filter **150**. The second housing portion **190**C may be provided with, for example, the field lens **170** and the light path converter **180**. The bent portion **190**B may be provided with a reflection member **160** such as a total reflection prism